NEEDLE NUMBER IN RED PINE

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Dendrology manuals and other texts list red pine (*Pinus resinosa* Ait.) as a two-needled pine. While the overwhelming number of fascicles do consist of the expected pair of needles, both infra- and supernumerary fascicles do occur. An indication of their frequency and distribution was obtained by an examination of ten healthy, 5-year-old, open-grown seedlings and 230 healthy, dominant trees 30 to 45 years old.

The ten five-year-old seedlings (2-1 transplants) averaged 51 cm in height and 14 mm in basal diameter. Each living fascicle was inspected, the total number of fascicles for the ten trees being 13,188. Of these 12,913 consisted of two needles, 252 consisted of three needles, 22 consisted of but one needle, while the remaining fascicle was made up of four needles.

The fascicles aberrant in number consisted of apparently normal mature leaves and were all enclosed in sheaths. Those consisting of one needle were circular in cross section; those consisting of three or four had needles more or less equal in size and shape and were circular or somewhat elliptical in combined cross section.

The aberrant fascicles found in the seedlings were restricted largely to a small zone at the distal end of an internode (i.e., stem section between branch whorls). Thus, 91% of the singlets, 61% of the triplets, and the lone quadruplet were found immediately subjacent to terminal buds (or where they had been grown past). While 15% of the three-needled fascicles were distributed more or less at random, the remaining 24% of the three-needled fascicles were found in a secondary area of concentration, a small zone at the proximal end of many of the internodes.

The 230 30-to-45-year-old trees inspected were plantation grown, had an average age of 38, and averaged 24 cm in diameter at 137 cm and 16 m in height. Thirty-six fascicles were sampled at random near the top of the crown from

each of the trees. Of the 8,280 fascicles thus inspected, all consisted of 2 needles except for two which were made up of three needles. These wer found subjacent to terminal buds, one on a 38-, the other on a 41-year-old tree. The data for the two age classes are summarized in Table 1.

Table 1. Fascicular needle number in *Pinus resinosa*

Number of Needles per Fascicle	*Frequency per 10,000* Age 5	Age 30-45
One	17	0
Two	9,791	9,998
Three	191	2
Four	1	0

Fascicular needle number, particularly amongst the different species of hard pines (Subgenus *Diploxylon*), is more or less variable and is more or less readily influenced by internal and external conditions.

That fascicular needle number is under the genetic control of multiple genes is indicated by the intermediate frequency distributions reported by Keng and Little (1961) for several intrasubgeneric hard pine hybrids. An examination of the two- and three-needled ponderosa pine (*Pinus ponderosa* Laws.) by Weidman (1939) disclosed an increase in the proportion of binate fascicles in a west-to-east traverse of the species. He discovered this to be a case of ecotypic variation since seed collected from throughout this range and raised in one locality for 22 or more years maintained the numeration of its parental origin. Doak (1934-1935) surmised the paucity of four-needled fascicles within the pine genus to be explicable on the basis of an evolutionary disadvantage of quadrifoliar fascicles and presented certain evidence in favor of this theory.

The present report has described the topophytic phenomenon of two zones of concentration of aberrant fascicles as well as the cyclophytic one of a lower frequency of aberrant fascicles in the older age class. Similarly, Ghent and Thomas (1960) reported for the predominantly two-needled jack

pine (*Pinus banksiana* Lamb.) that in young trees there is an area of concentration of three-needled fascicles subjacent to terminal buds, the frequency of these decreasing markedly with age. Haller (1962) found that predominantly three-needled ponderosa pines had a much higher frequency of two needles when young.

Certain more or less extraordinary developmental phenomena also give rise to aberrant needle numbers. Thus Ghent and Thomas (1960) reported a higher frequency of three-needled fascicles for the lammas shoots of jack pine. Haller (1962) observed that the stunted lateral branches of two- and three-needled ponderosa pines produced a much higher proportion of doublets than robust principle branches. Doak (1934-1935) described a predominantly two-needled mature Austrian pine (*Pinus nigra* Arn.) exhibiting the unusual feature of a bole covered with epicormic branches. Of the first 439 fascicles examined at random from these epicormic branches, he found 281 to consist of 3 needles, 100 of 2 needles, 56 of 5 needles, and 2 of 4 needles. In the present study, the only two shoots of interfoliar bud origin that were found were on one of the young red pines and possessed a much higher frequency of three-needled fascicles (19%) than did their neighbors of normal origin (2%). Borthwick (1896-1900) described a two- and three-needled Austrian pine sapling with a leader unusual in that it had produced no laterals for two years. This terminal growth was additionally unique in bearing many four-needled fascicles. These quadrifoliar fascicles, unlike the one found in the present study, were heterophyllous. While three of the needles were of similar size and combined to form a circle in cross section, the fourth was shorter and plano-convex in cross section and was found to originate from a hypertrophied scale of the interfoliar bud.

Regarding external influences, Harlow and Harrar (1958) reported the rare occurrence of three-needled fascicles on shoots of red pine infested with tip moths (*Rhyacionia buoliana* [Schiff.]).

According to Doak (1934-1935) it is a common observa-

tion that pines when heavily fertilized, irrigated, or otherwise subjected to unusually favorable conditions will tend to produce simple leaves. Seedlings of the mostly three-needled longleaf pine (*Pinus palustris* Mill.) were noticed by Pessin (1937) to produce a higher frequency of two-needled fascicles when the nutrient medium is markedly deficient in phosphorus. On the other hand, Schneider (1913) in studying the morphology of 16 species of pine concluded that in many cases fascicular supernumeration was positively correlated and infranumeration negatively correlated with favorable nutrient conditions. Similarly, Goebel (1960) observed that nitrogen fertilization tends to increase the number of needles per fascicle in the two- or more often three-needled loblolly pine (*Pinus taeda* L.) to four or even five.

It would be of great interest to explore the hormonal relationships between fascicular needle number and such factors as tree age and position within the crown and also to delve into the physiological mechanisms whereby environmental factors such as mineral availability and insect attack can influence fascicular morphogensis.

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PUBLICATION DATE FOR THE FLORA OF STOUGHTON

Due to an unfortunate oversight, the date of issue of The Flora of Stoughton, Massachusetts by Dr. Sidney Fay Blake was omitted. This work appeared on October 31, 1963.

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